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Indian Standard

PROCEDURE FOR STRAY FLUX TESTING OF FERRO-MAGNETIC SEAMLESS STEEL TUBULAR PRODUCTS

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

PROCEDURE FOR STRAY FLUX TESTING OF FERRO-MAGNETIC SEAMLESS STEEL TUBULAR PRODUCTS

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PROCEDURE FOR STRAY FLUX TESTING OF FERRO-MAGNETIC SEAMLESS STEEL TUBULAR PRODUCTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 5 February 1986, after the draft finalized by the Non-Destructive Testing Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 The flux leakage method of testing ferro-magnetic tubular products is capable of detecting the presence and location of significant longitudinally oriented defects such as, scabs, slivers, gouges, rollins, laps, seams, cracks, holes, etc, in such tubes. Additionally, the severity of a discontinuity may be estimated and a rejection level set with respect to the magnitude of the electromagnetic indication produced by the discontinuity.

0.3 The response from natural discontinuities can be significantly different from the response from artificial discontinuities, such as drilled holes or notches of equivalent depth. It is, therefore, necessary to establish the conditions for detection and marking of natural discontinuities whose characteristics will adversely affect the serviceability of the tube before applying this test method.

0.4 In the preparation of this standard assistance has been derived from ASTM E 570-1981 'Recommended practice for flux leakage examination of ferro-magnetic steel tubular products', issued by the American Society for Testing and Materials.

1. SCOPE

1.1 This standard prescribes the method of testing ferro-magnetic seamless steel tube/pipe having outside diameter from 20 to 650 mm with wall thickness up to 20 mm, using stray flux method for detection of longitudinal externel and internal discontinuities.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Flux Magnetic Leakage — The magnetic field that leaves or enters the surface of a part as the result of a discontinuity or a change in section.

3. PRINCIPLE OF TEST

3.1 The test is performed by passing the tube at a steady speed through a rotating chamber consisting of a magnetizing system and a sensing system. At a discontinuity in the tube/pipe wall, the flux lines are distorted, producing a leakage field. The maximum flux leakage normally occurs when magnetization is perpendicular to the discontinuity. Relative motion between the flux sensor and the flux leakage field caused by discontinuity is generally utilized to generate a voltage in the sensor. The signal amplitude of the voltage generated by the sensor is generally indicative of the severity of the discontinuity when all other factors are constant.

4. TEST EQUIPMENT

4.1 Rotating Chamber — Rotating chamber driven by a variable speed motor contains the magnetizing system and flux leakage sensors. This rotates in unison around the specimen that is being translated axially through the mechanism, thereby producing a helical scanning over the surface of the tube/pipe. Good examination practice requires that the pole pieces of the magnetizing system rotate uniformly about the tube and that flux sensors ride on the tube during rotation or be spaced uniformly above the surface of the tube during rotation.

4.2 Magnetizing System — The magnetizing system shall consist of a suitable means of applying a strong adjustable circumferencial magnetic field to the region of the tube under the flux sensors and shall be capable of bringing that region of the tube/pipe to near-saturation.

4.3 Flux Leakage Sensors — Sensors such as magneto-diodes, Hall probes and magneto resistors are electromagnetic transducers that respond to variations in magnetic flux density. These sensors are normally used to detect flux leakage directly from the discontinuity in the tube/pipe. The flux sensors should be of sufficient number and length so as to provide 100 percent coverage while scanning the tube/pipe surface to be tested at the desired examination speed.

4.4 Electronic Instrumentation — The electronic apparatus shall be capable of amplifying signals from the flux sensors and also of a classifying signals into internal and external flaws depending upon signal

configuration. Each of the two sets of electronic channels should contain its own sensitivity and threshold triggering controls for independent setting of percentage of wall thickness rejection levels.

4.5 Driving Mechanism — A mechanical drive mechanism shall be used which is capable of rigidly holding and passing the specimen concentrically through the inspection apparatus at constant speed.

4.6 Accessories — Either a recorder, an alarm and or a marking system shall be used alongwith the main equipment.

5. REFERENCE STANDARD

5.1 A reference standard free from interfering natural flaws shall be prepared from a tube of sufficient length, which shall be of same size, composition and metallurgical conditions as the tubes to be inspected.

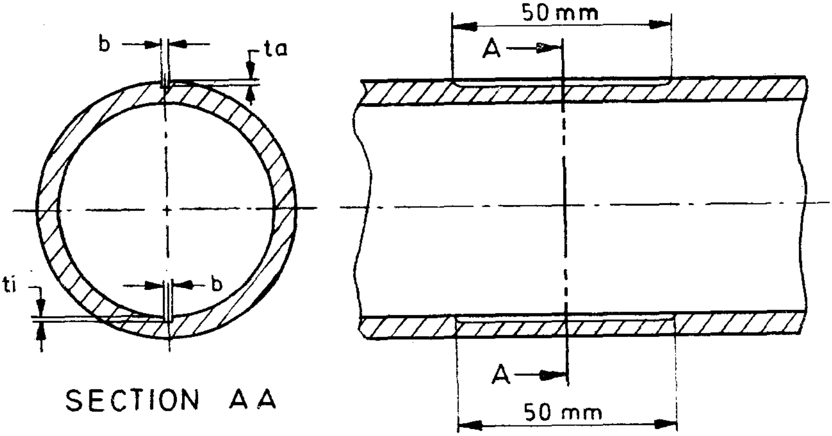
5.2 Surface Preparation — The surface of the tube shall be free from such metallic particles, other foreign material and roughness that may interfere with the interpretation of the test results.

5.3 Notches — Longitudinal outside and inside surface notches may be produced either by air abrasive, milling or EDM (*electric discharge machining*).

5.3.1 Notch width and geometry are relevant variables that can affect signal response and should be taken into consideration in applying this method. Notch depth is specified as a percentage of nominal wall thickness, namely, 5 percent or as agreed to between the contracting parties. Notch width shall be minimum but shall not exceed the depth. Notch length shall be 50 mm or twice the probe width whichever is less (*see* Fig. 1). Such a reference standard shall not be construed as a measure of size of any imperfection detectable by this method.

6. TEST PROCEDURE

6.1 Adjustment of the Equipment — The reference standard shall be passed through the rotary system and the notch shall be brought under the sensors. The magnetization power, flaw channel sensitivity and filter network shall be adjusted for optimum performance. The system shall be adjusted so as to obtain the optimum signal-to-noise ratio. The instrument should be set to mark such detected flaws. The setting of the instrument shall not be altered during testing of the lot. The alarm level and the marking mechanism shall be so set that an alarm or a mark is given each time a flaw passes the sensors.



t_a = Depth of outer longitudinal notch
t_i = Depth of inner longitudinal notch
b = Width of notch 0·7 to 0.8 mm
Tolerance for t_a and t_i = $\pm$ 15 percent

FIG. 1 REFERENCE TUBE FOR STRAY FLUX TESTING

6.2 Mode of Testing — The tube shall be passed through the equipment at a constant speed as done during calibration. Wobbling and vibration is avoided by proper guiding and the driving system. Any section of tubing, giving a flaw indication equal to or greater than that produced by the reference standard, shall be segregated for further salvaging work.

6.3 The proper functioning of the equipment shall be checked

a) At the beginning and end of she shift;

b) At every four hours of continuous operation, and whenever malfunction is suspected; and

c) Tube shall be demagnetized suitably in view of the end use of the tube.

If malfunctioning is confirmed all the tubes which have been tested since the last satisfactory calibration shall be retested.

6.4 Level of Acceptance — The acceptance standard shall be based on the setting of the instrument to a sensitivity adequate to detect the artificial flaw of the reference specimen.